Watershed Protection: A Project Focus
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Chapter 8: Measuring Success and Making Adjustments

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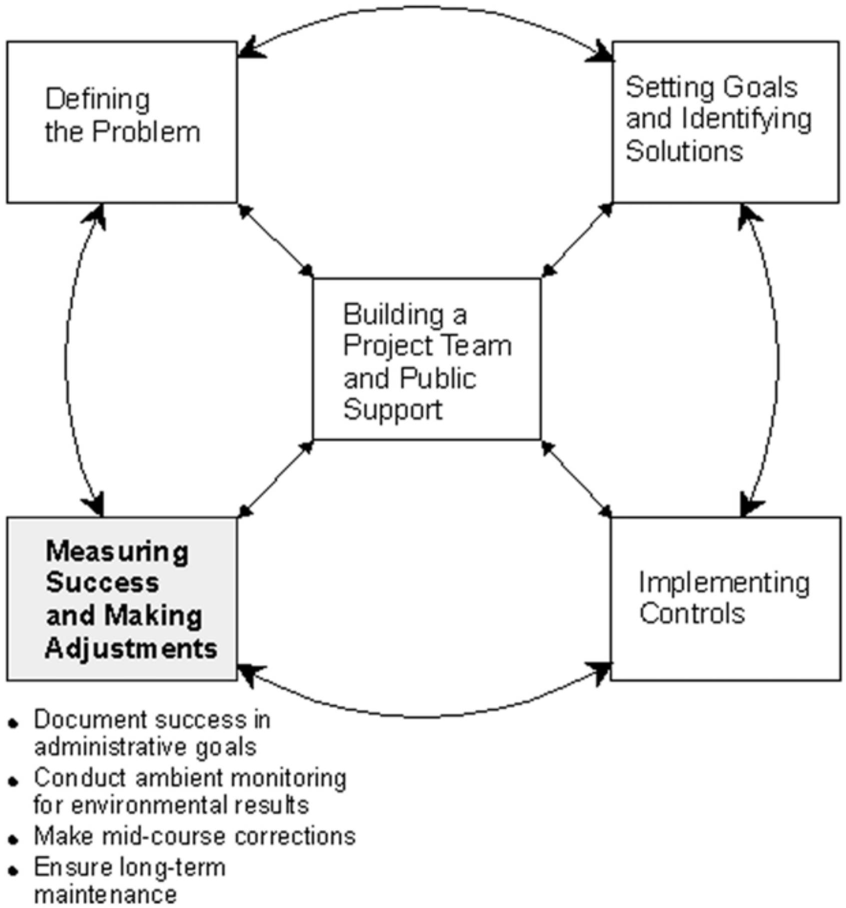

This chapter discusses the importance of documenting the success of a watershed project and making mid-course corrections based on these measurements. Funding agencies, landowners, and the general public want to know that the goals of the watershed project will be achieved if they invest in pollution control and restoration. Proving effectiveness is one of the most difficult tasks in a watershed project.

Document Success in Administrative Goals

Progress in achieving goals must be reported clearly and regularly to sponsoring agencies and organizations and the public to stay on target, make the most efficient use of resources, and maintain public support. Of course, improving or protecting water quality is the major goal in most watershed projects, but detecting trends in ambient water quality can take 10 years or more. In the meantime, administrative goals can be important interim measures of success.

Four types of administrative goals were outlined in Chapter 6: program goals, activity goals, BMP goals, and interim water quality goals. Following are several approaches that can be used to monitor results.

Type of Goal	Approach
Program goals	Periodic written reports, public meetings, and financial records (documentation of shifts in time and resources).
Activity goals	Simple tracking forms or data files for each responsible agency to report progress by activity (e.g., educational presentations, irrigation system evaluations, septic tank installation inspections).
BMP goals	Reports, maps and photographs of specific controls and restoration devices installed(e.g., animal waste lagoons, restored streambank, stormwater detention ponds).
Interim water quality goals	Qualitative and quantitative results of instream quality goals monitoring and BMP effectiveness monitoring. Trends in chemical or biological metrics can sometimes be dramatic (even if not at a high confidence level statistically). Visual documentation of water body improvements can also be convincing.

Highlight 16 discusses ways in which the Anacostia River Restoration Program communicates progress toward environmental goals.

Conduct Ambient Monitoring for Environmental Results

Water quality monitoring is done for several purposes during the life of a typical watershed project:

- to assess baseline conditions
- to detect trends in ambient (e.g., instream) water quality
- to measure the pollutant-removal efficiencies of controls
- to demonstrate the effectiveness of restoration measures
- to monitor the long-term maintenance of controls.

Highlight 16

Reporting Progress in Anacostia River Restoration

The Anacostia Restoration Program communicates progress through an excellent series of publications and through direct contact with the public. Examples include:

A detailed annual progress report, The State of the Anacostia, presenting results of the year's monitoring efforts, installation of CSO and stormwater controls, stream restoration projects, riparian corridor protection, public participation, and many other features. The reports are written for a lay audience with some science background. Selected pages from the 1989 Status Report are included in Appendix A of this document.

Slide presentations to civic associations, environmental groups, and community leaders by part-time coordinators in 9 sub-watersheds; the coordinators also lead stream walks and distribute literature

A series of sub-watershed educational documents, the first of which was "Restoring Watts Branch."

A quarterly newsletter devoted to restoration and citizen accomplishments in the watershed.

Source: MWCOG, 1990

Monitoring design is critical; however, a detailed discussion is beyond the scope of this document. Several references are listed in the bibliography (Chapter 9); below are several key considerations for monitoring in watershed projects.

It is not necessary to prove the effectiveness of every control device or restoration effort in the watershed. Rigorous monitoring of selected areas is better than widely scattered efforts. For example, the efficiency of certain BMPs may have been proven already in other, similar watershed studies; if so, monitoring resources can be best spent in other areas such as biological monitoring.

Because of cost, monitoring design should limit the number of parameters for study. These parameters are driven by the environmental indicators, goals, and quantifiable objectives of the watershed project.

Watershed monitoring should include physical and chemical parameters as well as more direct measures of aquatic health--measures of fish population and community structure, bottom-dwelling organisms (e.g., benthic macroinvertebrates), and habitat quality.

Regarding Item 3, most projects have a major goal of attaining aquatic life uses in their water bodies. Historically in watershed projects, physical and chemical parameters alone were considered sufficient to show this attainment--e.g., parameters such as water temperature and concentrations of sediment, dissolved oxygen, nitrogen and phosphorus. These are the typical parameters or pollutants controlled by wastewater treatment and nonpoint source BMPs. The Watershed Protection Approach, on the other hand, promotes a broader view--that ecological integrity is attainable when physical and chemical integrity and biological/habitat integrity occur simultaneously (Figure 8-1). Therefore, watershed monitoring should include biological and habitat measures of aquatic life in Item 3 above. Figure 8-2 lists some of the parameters used to measure aquatic health in the Anacostia Restoration Project, which has a progressive biological monitoring program. Highlight 17 relates monitoring in the Anacostia watershed to the program's goals.

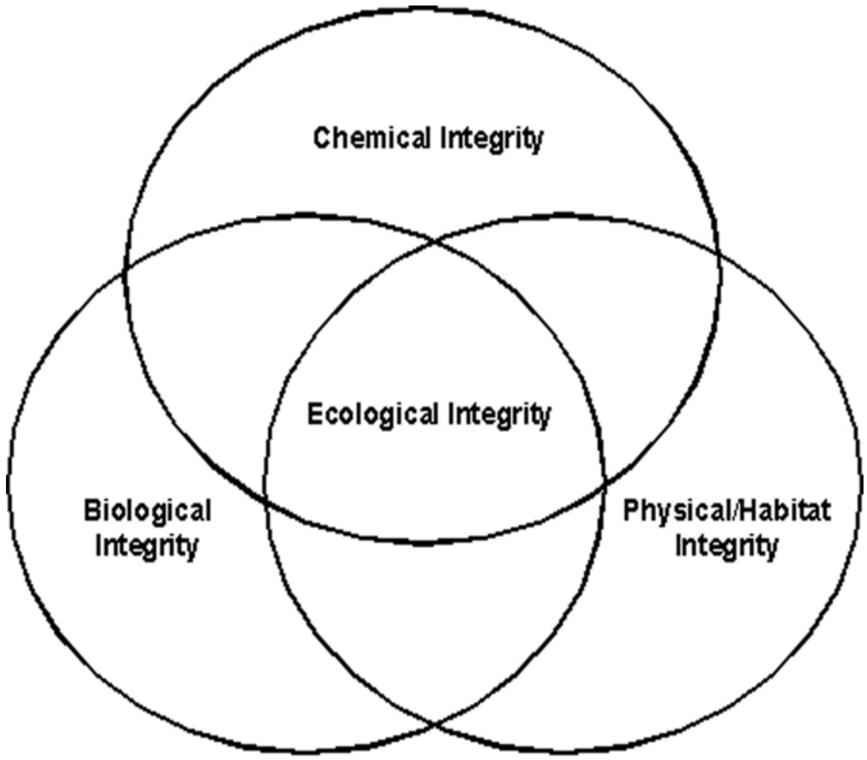

Figure 8-1. Elements of ecological integrity in aquatic systems (adapted from EPA, 1991c).

Routine physical and chemical sampling (grab sampling) is generally done at least monthly. Nonpoint source special studies often emphasize storm event sampling to measure effectiveness of controls. Storm event sampling is expensive, however, and in most cases requires installation of automatic sampling devices. Biological/habitat monitoring can be done much less frequently; seasonal or annual sampling is normally adequate. This type of monitoring does require the help of expert biologists, who are often available through state water quality and fisheries agencies and through universities.

Citizen Monitoring

Citizens can provide valuable support to the project by collecting water quality samples, identifying water quality problems, and gathering photographic documentation. Citizen monitoring programs have reached a new level of sophistication in recent years, including certification programs for volunteers and preparation of quality assurance management plans. Citizen monitoring programs have also moved into the realm of biological monitoring with training from experts. Guidance and technical transfer information is available from EPA Headquarters (EPA, 1990b) and may be available at the state level. For example, the states of Kentucky, Illinois, Minnesota, and Texas have well-developed citizen monitoring programs.

Figure 8. Biological and habitat monitoring measures in the Anacostia River Restoration Project

Stream Habitat Measures	Bottom substrate/instream cover Embeddedness Flow Canopy cover Channel alteration Bottom scouring and deposition Pool-to-riffle ratio Lower bank channel capacity Upper bank stability Degree of bank vegetative protection Streamside cover Riparian vegetative zone width
Macroinvertebrate Measures	Taxa richness--total number of number of species or genera Hilsenhof Biotic Index--a measure of pollution tolerance of the organisms present Number of mayfly, stonefly, and caddisfly taxa (pollutant-intolerant insects) % contribution of the dominant taxon to total organisms Ratio of mayfly, stonefly, and caddisfly individuals to Chironomids (pollution-tolerant worms) Ratio of the number of detritus-shredding organisms to total organisms

	Ratio of scrapers to filter collectors--indicates relative dominance of particular feeding types
Fish Measures	Total number of species Number of darter, sculpin and madtom species (sensitive to siltation and oxygen depletion) Number of sunfish species Average size of principal gamefish Number of intolerant fish species Proportion of carp, white suckers, northern creek chub and blacknose dace (pollution-tolerant) Proportion of omnivorous/generalist individuals (increases as conditions deteriorate) Proportion of fish having disease/anomalies--depicts the health of individual fish

Highlight 17

Monitoring in the Anacostia Watershed

The Anacostia River Restoration Program conducts water quality monitoring in support of four of the program's six goals. Results are summarized both in technical publications and in detailed annual status reports for lay readers (e.g., MCOG, 1990). Following are some elements of the Anacostia monitoring effort as related to these program goals.

Goal 1 - Reduce pollutant loads Baseline water chemistry monitoring throughout sub-watersheds prior to BMPs or stream restoration activities Performance monitoring of nonpoint source controls (pollutant removal) Automatic sampling stations at the base of selected sub-watersheds to measure storm loads of phosphorus, nitrogen, sediment, organic carbon, trace metals and hydrocarbons
Goal 2 - Protect and restore ecological integrity of urban streams An annual water quality index based on 15 stations in the Coordinated Anacostia Monitoring Program (multiple agencies participate) Intensive biological and habitat surveys (baseline and post-implementation) of over 40 sites in selected sub-watersheds; generally follow EPA's Rapid Bioassessment Protocols for macroinvertebrates and fish Special studies of urban impacts (e.g., temperature effects of urbanization; watershed imperviousness vs. fish diversity)
Goal 3 - Restore spawning range of anadromous fish Monitoring of fish spawning runs Routine fish sampling
Goal 6 - Increase public awareness and participation Stream walks, photographic documentation of water quality conditions and habitat improvements

Make Mid-course Corrections

Midway through a watershed project, it is likely that at least one of the following problems will occur:

Monitoring indicates that the wrong problem is being solved

Solving one problem unmasks another problem that is more difficult to control

The project reaches some program or activity goals but may not be effective enough to reach the water quality goals

Quantifiable objectives (e.g., pollutant load reduction) were set too low to solve the problem.

These unpleasant realizations occur due to data gaps; most projects do not have access to extensive land use and water quality databases and mapping and modeling tools. It is important for the project team to recognize this possibility from the outset and to build into the project yearly evaluations and an agreed-upon halfway point where all aspects of the project can be revised if necessary. Highlight 18 presents mid-course corrections in the Rock Creek, Idaho watershed.

Citizens and funding agencies tend to feel misled if they are surprised to learn at the end of a project that it is not going to work out as planned, especially if someone has promised them a total solution. Regular evaluations can help detect problems early. Different groups should evaluate each portion of the project independently using the same evaluation criteria that were agreed upon before the project began. At a minimum, an annual meeting of all evaluators should be held to compare notes and reach consensus on:

- Overall project performance
- List of actions and controls that must be changed and the process and timetable to do so.

Evaluation questions that have helped other watershed projects make mid-course corrections include:

- Are the correct controls/restoration measures being installed in the target areas first?
- Are they being installed correctly and on schedule?
- Do the controls appear effective?
- What visual evidence is there to support this?
- What do the water quality data show?
- How are biological systems responding?
- Are all cooperators meeting commitments for time, funds, labor, and other resources?

Highlight 18

Mid-course Corrections at Rock Creek, Idaho -- A Management Effort in Three Acts

Rock Creek is a tributary to the Snake River in an arid area of southern Idaho. The headwaters for Rock Creek lie in the Sawtooth National Forest, and the middle and lower reaches of the system feature intensive irrigation farming. Water is diverted from the Snake River, and the irrigation systems create the potential for impacts from irrigation return flows in addition to soil erosion and habitat alterations from cropping practices and livestock grazing.

Starting in the early 1980s, Rock Creek was the focus of a Rural Clean Water Program (RCWP) project with an active monitoring component. The RCWP period, which ended in 1991, can be viewed as the second of three "acts" in a long process of environmental improvements. Each stage overcame major pollution problems and paved the way for additional goals to restore fully the integrity of Rock Creek.

ACT I: Overcoming a Heritage of Neglect

By the 1960s, state and federal natural resource agencies began to document severe impacts from point source discharges and crop and livestock agriculture. Domestic rubbish and even car bodies were being dumped in Rock Creek. The fishery resource was in poor condition and fecal coliform levels showed frequent violations of public health standards. In the 1970s, most significant point source discharges were diverted to avoid the system, leaving agriculture as the main source of water quality problems.

ACT II: Applying BMPs to Agricultural Land Uses

By the late 1980s, 182 landowner management plans had been developed and implemented. Site-specific variations of nine agricultural BMPs were stressed including: permanent vegetative cover, animal waste control systems, conservation tillage, stream protection at critical erosion points, permanent vegetative cover on highly erosive areas, sediment detention and erosion structures, improved irrigation water conservation, fertilizer management, and pesticide management.

A well-designed monitoring program documented substantial reductions in the loadings of such parameters as phosphorus and suspended solids. Despite these gains, monitoring and bioassessment work showed that additional improvements were still needed to make sure the stream was safe for primary body contact recreation and to further lower sediment inputs to restore a self-sustaining salmonid fishery.

ACT III: Lessons Learned and Work for the Future

The final barriers to meeting the goals set forth under the RCWP project have to do with habitat conditions. The RCWP BMPs had focused on mitigating the impacts of agricultural land uses, and particularly the inputs of pollutants from the irrigation return flows. However, during monitoring, processes such as streambank erosion were found to contribute two to three times the sediment loadings as cropped land surfaces or irrigation ditches. To reduce these loadings, it will be necessary to carry out protection and restoration measures in the riparian zones. As the streambanks are stabilized and riparian vegetation cover is re-established, the fecal coliform concerns should also be ameliorated. Stakeholders in the RCWP project have pledged to continue the implementation of needed management measures. At the end of Act III, the goal of restoring Rock Creek to a condition supporting fishing and swimming now looks attainable.

Source: Rock Creek Project Board, 1991.

Ensure Long-term Maintenance

One of the least discussed and most difficult parts of a project is maintenance. Many projects have failed when outside funding ended or when the perceived problems were solved. A watershed action plan must provide for regular and ongoing maintenance in order to ensure success.

The concept of long-term maintenance is difficult for project managers, because there can often be no assurance of funding for maintenance after the life of the project. However, if at all possible, institutional and financial arrangements should be made that have a high probability of extending past the end of the funding period.

Cooperators should agree to perform the management measures and to continue operation and maintenance on structural and vegetative BMPs even if the economics of the situation change. New growth (new housing developments, animal operations, highways, etc.) should be held to the BMPs and pollution control measures used in the project (or a higher level of treatment if needed) without expecting compensation via cost-share or other grant monies. These newcomers should include pollution control as a part of the cost of doing business. Some key points to consider are:

Education and training of newcomers and continuing education and reinforcement for current cooperators is essential.

Maintenance programs should be self supporting whenever possible. Individuals and businesses, as well as municipalities and natural resource agencies, should be aware of the long-term need to provide for maintenance of controls.

A project that has developed and encouraged private-enterprise support services for BMP maintenance is much more likely to succeed.

Local regulations can be helpful to maintain water quality gains; demonstration of success may be needed first.

Project managers should contact their counterparts in well-established programs such as the Anacostia, Chesapeake Bay, Puget Sound, and Rock Creek Projects to gain insight on maintaining support for a watershed project. Contacts for these programs can be obtained through the EPA Regions and the EPA Office of Wetlands, Oceans, and Watersheds in Washington, DC. See Chapter 9 for references from the literature.